	Type	Hits	Search Text	DBs
9	BRS	9	(((345/7,8,9, 359/13,630,63, 250/260.1,260.2, 701/1,23, 24,200,207, 208, 209, 225, 300, 301, 302, 342/1,42,357,450, 353/11,12,13, 356/3,27) and ((non-motorized adj vehicle) or (motor adj vehicle) or (movi$4 adj person))) and display) and ((head adj mount$5) with display)	USPAT; US-PGPUB
10	BRS	89	(((345/7,8,9, 359/13,630,63, 250/260.1,260.2, 701/1,23, 24,200,207, 208, 209, 225, 300, 301, 302, 342/1,42,357,450, 353/11,12,13, 356/3,27) and ((non-motorized adj vehicle) or (motor adj vehicle) or (movi$4 adj person))) and display) and ((projec$5 or HMD)with display)	USPAT; US-PGPUB
11	BRS	3	(((345/7,8,9, 359/13,630,63, 250/260.1,260.2, 701/1,23, 24,200,207, 208, 209, 225, 300, 301, 302, 342/1,42,357,450, 353/11,12,13, 356/3,27) and ((non-motorized adj vehicle) or (motor adj vehicle))) and ((overli$4 or superimps$3)with display)) and display	USPAT; US-PGPUB
12	BRS	5	((non-motorized adj vehicle) or (motor adj vehicle)) and ((overli$4 or superimps$3)with display) and display	USPAT; US-PGPUB

	Type	Hits	Search Text	DBs
13	BRS	1	((non-motorized adj vehicle) or (motor adj vehicle)) and ((overli$4 or superimps$3) with display) and display	EPO; JPO; DERWENT; IBM_TDB
14	BRS	5	((non-motorized adj vehicle) or (motor adj vehicle)) and ((overli$4 or superimps$3) with display)	USPAT; US-PGPUB
15	BRS	68	(((non-motorized adj vehicle) or (motor adj vehicle) or (movi$4 adj person)) and display) and ((head adj up) with display)	USPAT; US-PGPUB
16	BRS	840	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) and (display with (side rear))	USPAT; US-PGPUB
17	BRS	183	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) and (display with ((side rear) adj3 view))	USPAT; US-PGPUB
18	BRS	28	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with ((side rear) adj3 view))	USPAT; US-PGPUB
19	BRS	25	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with ((side) near5 view))	USPAT; EPO; JPO; DERWENT; IBM_TDB
20	BRS	15	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with ((side rear) near5 (driver operator)))	USPAT; EPO; JPO; DERWENT; IBM_TDB

	Type	Hits	Search Text	DBs
21	BRS	9	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with ((side) near5 (driver operator)))	USPAT; EPO; JPO; DERWENT; IBM_TDB
22	BRS	12	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with (rearview adj2 mirror))	USPAT; EPO; JPO; DERWENT; IBM_TDB
23	BRS	12	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display with (rearview adj2 mirror))	USPAT; EPO; JPO; DERWENT; IBM_TDB
24	BRS	12	((non-motorized adj vehicle) (motor adj vehicle) (movi$4 adj person)) with (display same (rearview adj2 mirror))	USPAT; EPO; JPO; DERWENT; IBM_TDB

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United States Patent [19]

Sumiyoshi

[11] Patent Number: 5,734,358

[45] Date of Patent: Mar. 31, 1998

[54] **INFORMATION DISPLAY DEVICE FOR MOTOR VEHICLE**

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[73] Assignee: **Kansei Corporation**, Omiya, Japan

[21] Appl. No.: **676,912**

[22] Filed: **Jul. 8, 1996**

Related U.S. Application Data

[63] Continuation of Ser. No. 399,369, Mar. 6, 1995, abandoned.

[30] **Foreign Application Priority Data**

Mar. 18, 1994 [JP] Japan 6-048164
Mar. 23, 1994 [JP] Japan 6-051861

[51] **Int. Cl.**[6] **G09G 5/00**

[52] **U.S. Cl.** **345/7**; 345/9; 340/980; 359/630

[58] **Field of Search** 345/1, 7, 8, 9, 345/4, 22; 340/461, 462, 980; 359/630, 631, 13, 14; 348/113, 115, 121, 783

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Primary Examiner—Dennis-Doom Chow
Attorney, Agent, or Firm—Foley & Lardner

[57] **ABSTRACT**

An information display device comprises a housing installed in an instrument panel of a motor vehicle. The housing has a window opening facing toward the vehicle cabin. A first display device is installed in the housing and has a screen on which a first image is displayed. A second display device is installed in the housing and has a screen on which a second image is displayed. A half mirror is installed and inclined in the housing in a manner to cover the screens of both the first and second display devices, so that the image forming light beams from the screens are reflected backward by the half mirror. A concave mirror is installed in the housing behind the half mirror, so that the image forming light beams from the half mirror are reflected forward by the concave mirror. The first and second display devices are positioned at laterally spaced positions in the housing, so that first and second virtual magnified images produced by the respective light beams from the concave mirror can be viewed or recognized from only two positions respectively.

20 Claims, 7 Drawing Sheets

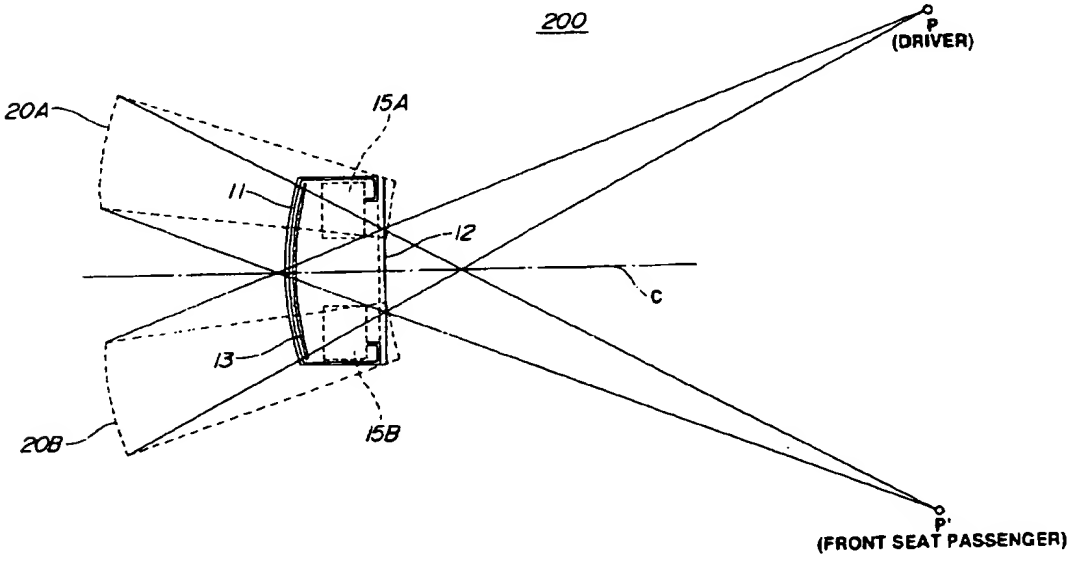


FIG.1

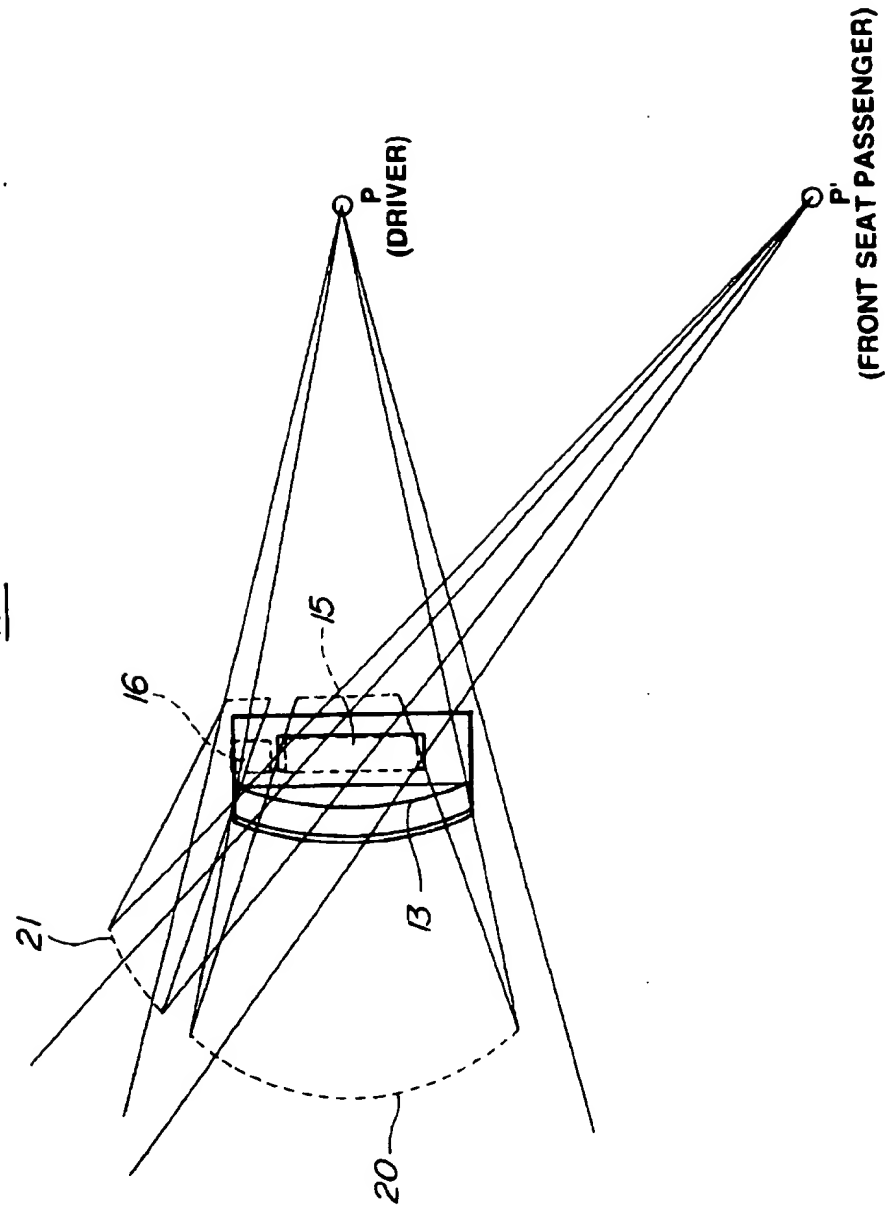


FIG.2

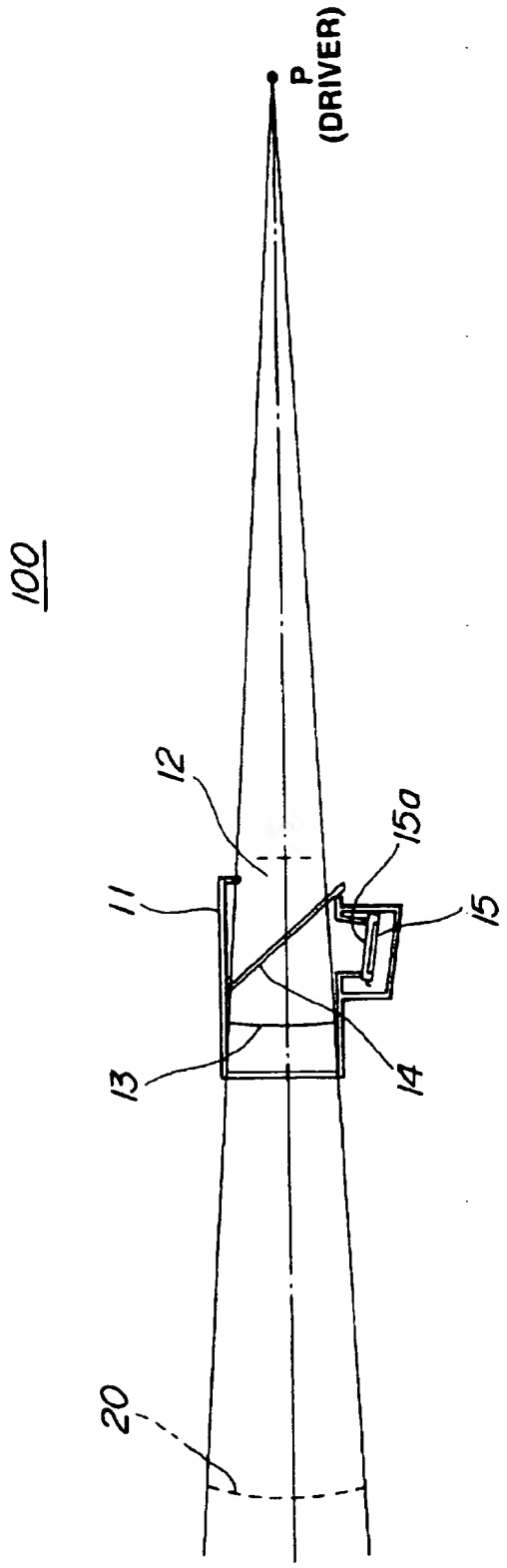


FIG.4

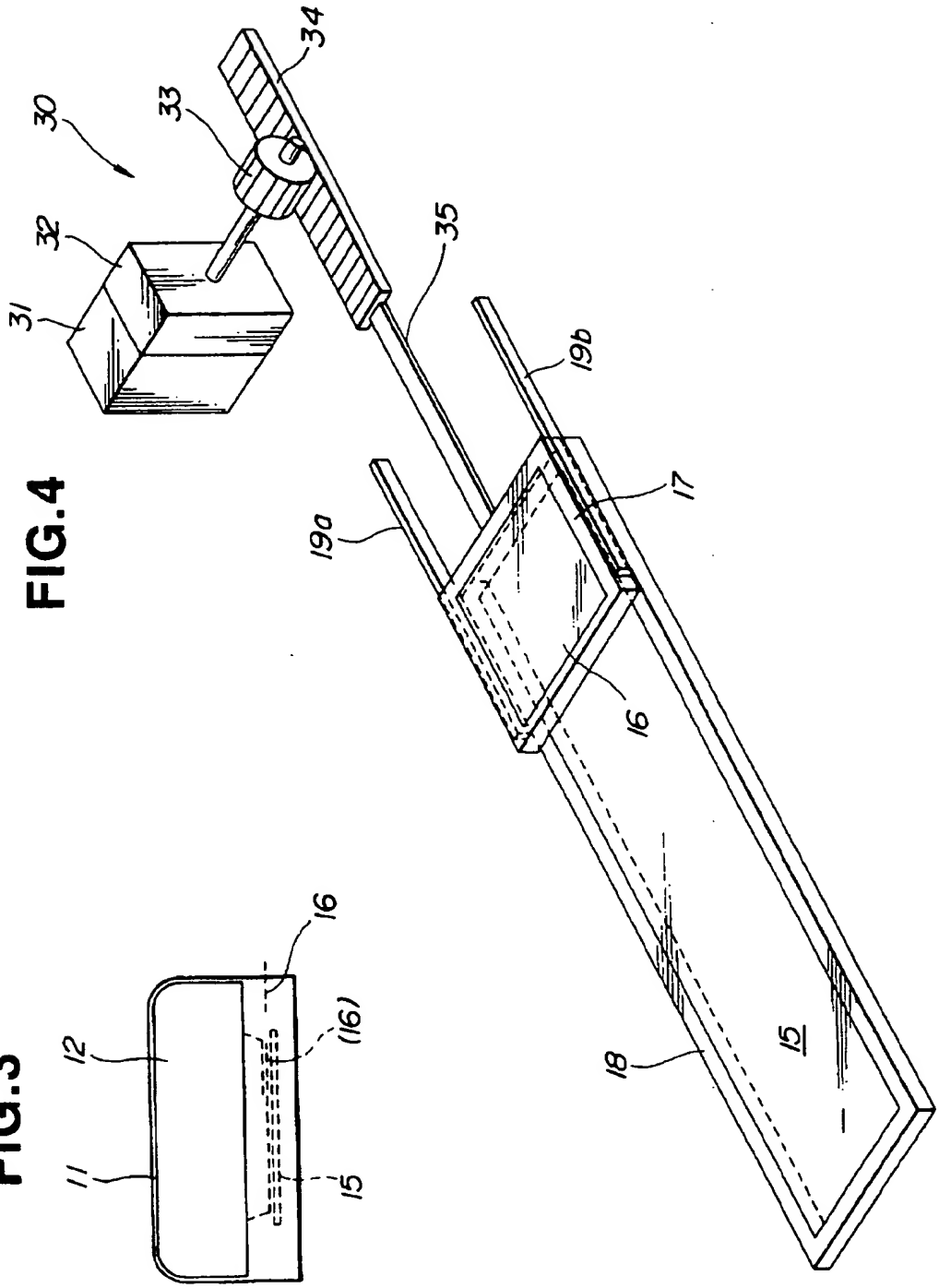


FIG.3

FIG.5

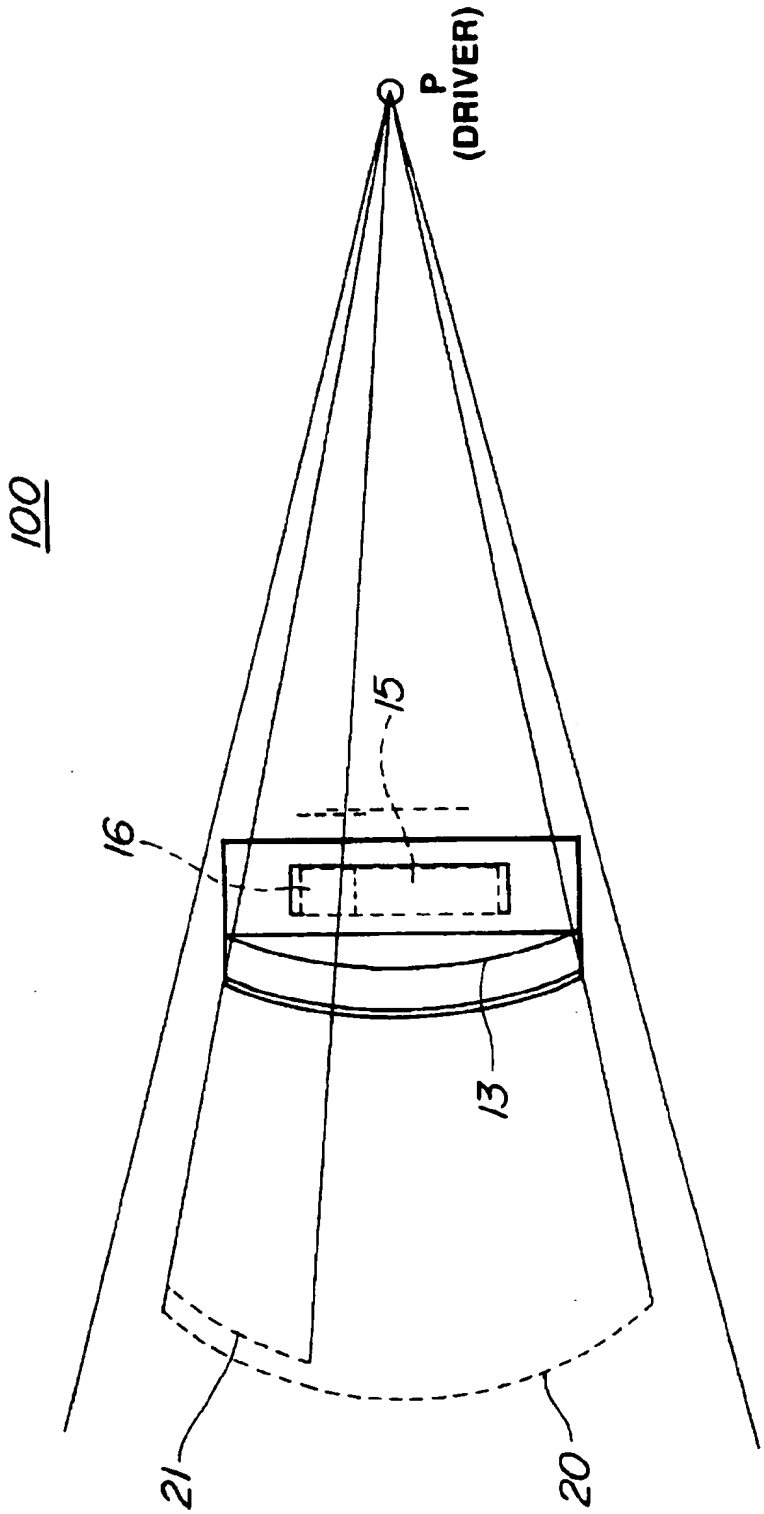


FIG.6

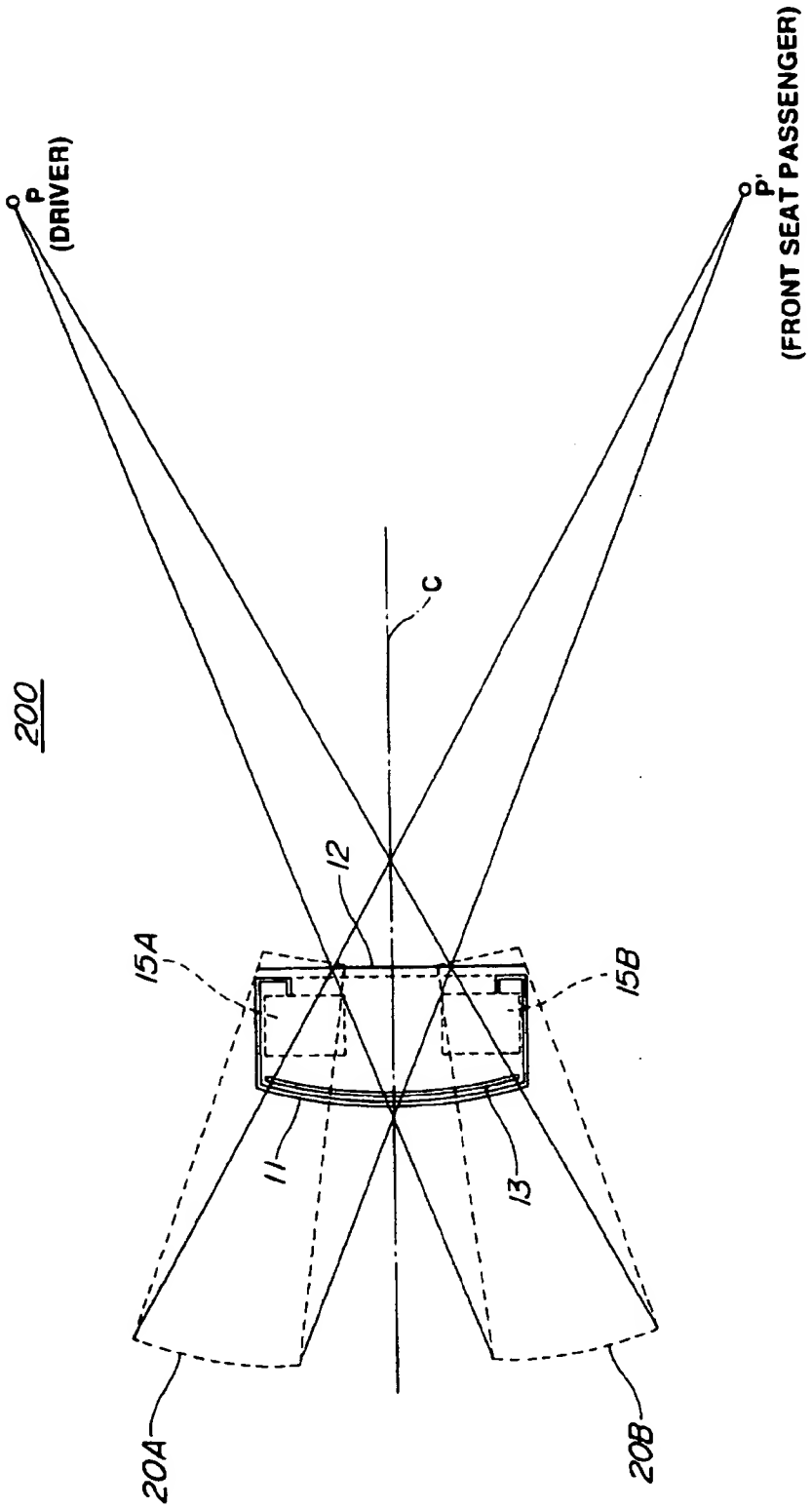


FIG.7

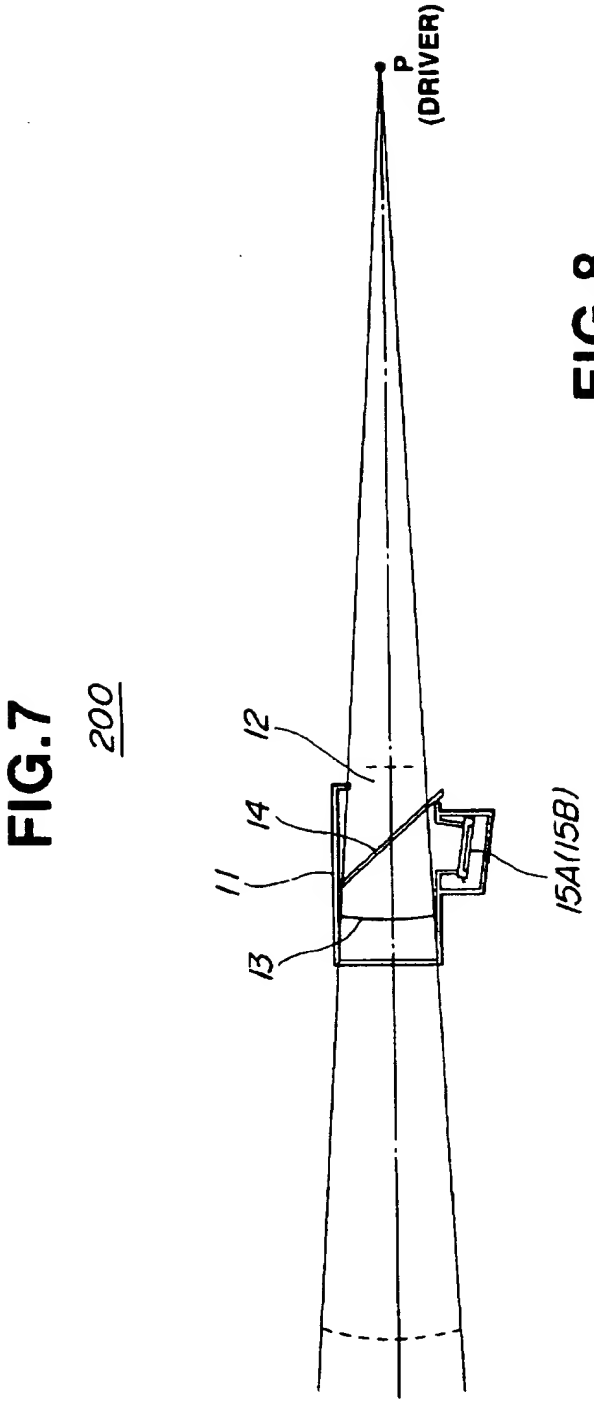


FIG.8

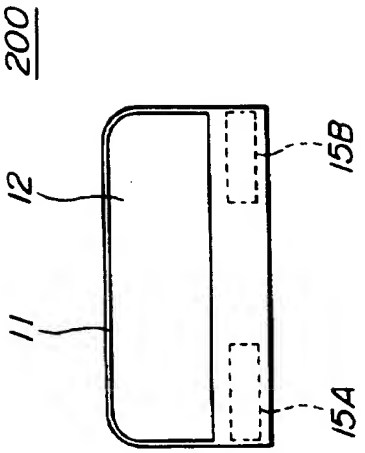


FIG.9
(PRIOR ART)

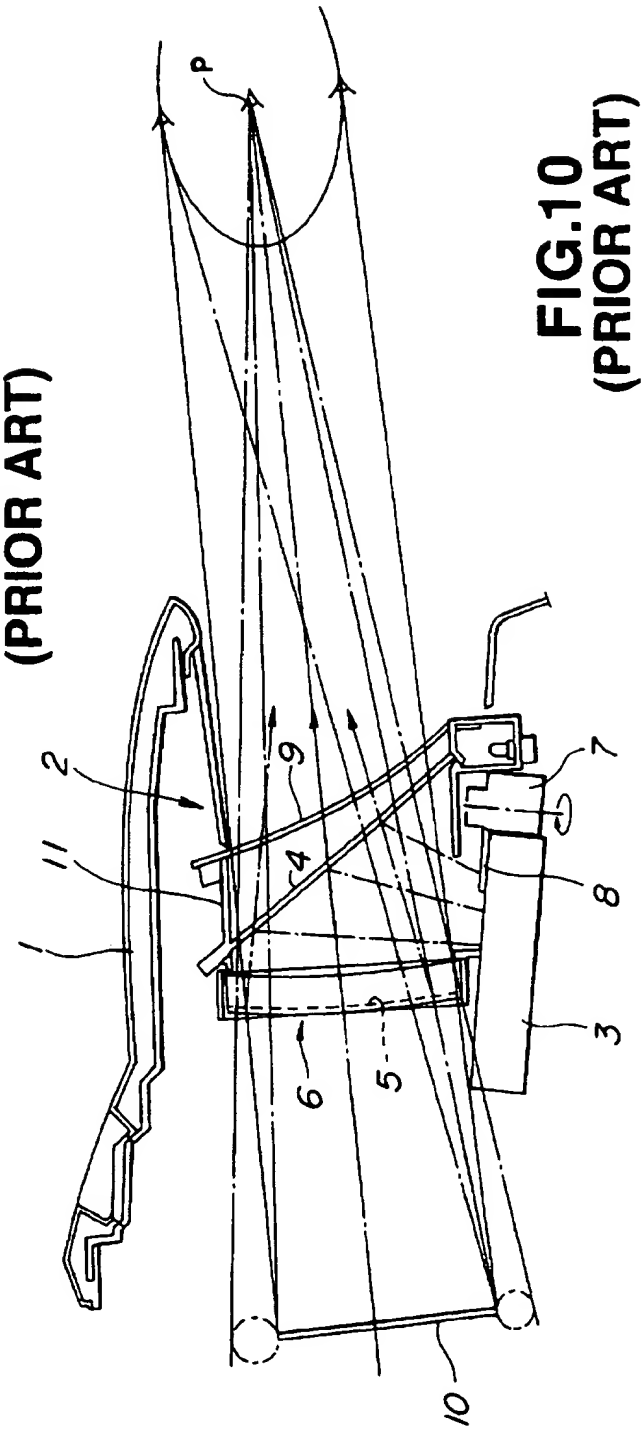
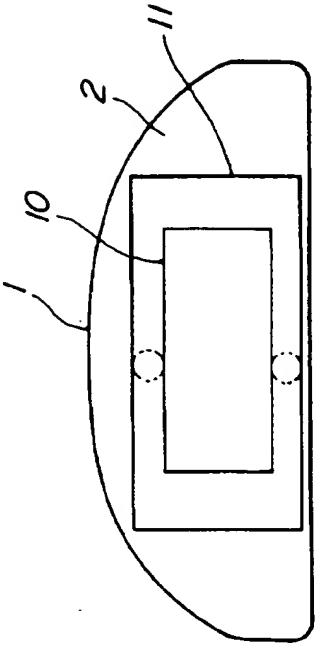


FIG.10
(PRIOR ART)



INFORMATION DISPLAY DEVICE FOR MOTOR VEHICLE

This application is a continuation of application Ser. No. 08/399,369, filed Mar. 6, 1995, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to information display devices for a motor vehicle or the like, and more particularly to the information display devices of a type which comprises a display device having a small screen on which visual information is displayed and an optical magnifying system providing a viewer, that is, driver or the like, with an optically magnified image of the displayed information on the screen.

2. Description of the Prior art

In order to clarify the task of the present invention, one conventional information display device for a motor vehicle will be described in brief with reference to FIGS. **9** and **10** of the accompanying drawings.

In FIG. **9**, designated by numeral **1** is an instrument panel of a motor vehicle, which has a display device mounting space **2** formed therein. Within the space **2**, there is installed a housing **11** having a window opening directed toward the vehicle cabin. Within the housing **11**, there is laid a display device **3** which displays on its screen various information needed by the driver, such as, vehicle speed, engine speed, coolant temperature, fuel residual quantity and the like. A half mirror **4** is positioned above the display device **3** and inclined relative to the screen of the device **3**. The image on the screen, viz., the information displaying light beam from the screen is thus reflected backward, that is, leftward in the drawing, by the half mirror **4**. A concave mirror **5** is positioned behind the half mirror **4** for magnifying the reflected image traveling from the half mirror **4**. The magnified image is thus directed toward an eye point "P" of a driver through the half mirror **4**. The half mirror **4** and the concave mirror **5** thus constitute an optical magnifying system **6**. Designated by numeral **7** is an indicator drive device which drives indicators on the screen of the display device **3**. One of the indicators is illustrated, which is denoted by numeral **8**. Thus, a magnified virtual image **10** of the displayed information on the screen appears ahead of the instrument panel **1**, which can be viewed by the driver. Denoted by numeral **9** is a transparent cover which covers a front portion of the display device, as shown.

However, due to its inherent construction, the above-mentioned conventional information display device has a drawback. That is, to a front seat passenger (viz., the passenger sitting beside the driver's seat), it is difficult to view the virtual image **10** provided by the display device. This is inconvenient particularly when the front seat passenger is an instructor who is teaching the driving technique to the driver.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an information display device for a motor vehicle, which is free of the above-mentioned drawback.

According to the present invention, there is provided an information display device for use in a motor vehicle having an instrument panel. The information display device comprises a housing installed in the instrument panel, the housing having a window opening which faces toward the vehicle cabin; a first display unit installed in the housing and having an upward facing screen on which a first image is displayed; a second display unit installed in the housing and having an upward facing screen on which a second image is displayed; a half mirror installed and inclined in the housing and positioned above both of the first and second display units in a manner to cover the screens of both the first and second display units, so that the image forming light beams from the respective screens of the first and second display units are reflected toward the front of the vehicle by the half mirror; and a concave mirror installed in the housing to reflect the image forming light beams from the half mirror, toward the vehicle cabin through the window opening, the reflected image forming light beams from the concave mirror produce respective magnified virtual images of the first and second images wherein the respective screens of the first and second display units are laterally spaced with respect to the vehicle cabin, so that the magnified virtual image of the first image can be viewed from only the first given position and the magnified virtual image of the second image can be viewed from only the second given position.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the present invention will become apparent from the following description when taken in conjunction with the accompanying drawing, in which:

FIG. **1** is a schematic plan view of an information display device of a first embodiment of the present invention, with the visual field provided by the device;

FIG. **2** is a schematic side view of the information display device of the first embodiment, with the visual field provided by the device;

FIG. **3** is a schematic front view of the information display device of the first embodiment;

FIG. **4** is a perspective view of a display moving mechanism employed in the information display device of the invention;

FIG. **5** is an illustration of the information display device of the first embodiment, which is taken from the direction in which a screen is viewed;

FIG. **6** is a schematic plan view of an information display device of a second embodiment of the present invention, with the visual field provided by the device;

FIG. **7** is a schematic side view of the information display device of the second embodiment, with the visual field provided by the device;

FIG. **8** is a schematic front view of the information display device of the second embodiment;

FIG. **9** is a schematically illustrated sectional view of a conventional information display device; and

FIG. **10** is schematic front view of the conventional information display device.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1** to **3**, there is shown an information display device of a first embodiment of the present invention, which is generally designated by numeral **100**.

In FIG. **2**, designated by numeral **11** is a housing which is to be mounted in the display device mounting space **2** (see FIG. **9**) formed in the instrument panel **1**. The housing **11** has a window opening **12** which faces toward the vehicle cabin. A concave mirror **13** is arranged in a depth portion of the housing **11**. A half mirror **14** is arranged in the housing **11**

between the window opening 12 and the concave mirror 13 and inclined relative to the housing 11.

Below the half mirror 4, there is arranged a fixed display unit 15 which has a screen 15*a* on which information is displayed. The display unit 15 comprises a liquid crystal display which displays various information needed by the driver, such as, vehicle speed, engine speed, coolant temperature, fuel residual quantity and the like.

As is seen from FIGS. 1, 3, 4 and 5, a movable display unit 16 is arranged beside the fixed display device 15. The movable display unit 16 comprises a liquid crystal display which may display TV and/or a navigation map.

As is best shown in FIG. 4, the movable display unit 16 has a rectangular frame 17 mounted thereabout. The movable display unit 16 is slidably disposed on parallel rails 19*a* and 19*b* which are secured to one end of the frame structure 18 of the fixed display unit 15. As shown, the parallel rails 19*a* and 19*b* extend longitudinally beyond the end of the frame structure 18, so that the display unit 16 can move between a first position as shown in the drawing and a second position which is far from the operative position. That is, in the first position, the movable display unit 16 is positioned above a given end portion of the screen 15*a* of the fixed display unit 15. Thus, the given end portion of the fixed display unit 15 is concealed by the movable display unit 16. While, in the second position, the movable display unit 16 is positioned just beside the fixed display unit 15 exposing the given end portion of the display unit 15.

As is understood from FIG. 1, upon assembly in a motor vehicle having a steering wheel at the right side, the information display device 100 is so oriented that the movable display unit 16 is positioned at a right side of the information display device when viewed by the driver. Furthermore, when assuming the second position as shown in FIG. 1, the movable display unit 16 is positioned near the right edge of the concave mirror 13 for the reason which will be apparent hereinafter.

A drive mechanism 30 is further employed for driving the movable display unit 16. The mechanism 30 comprises an electric motor 31, a speed reduction gear 32 operatively connected to the motor 31, a pinion 33 disposed on an output shaft of the speed reduction gear 32, a rack 34 meshed with the pinion 33 and a connector 35 connecting the rack 34 with the movable display unit 16. That is, when the motor 31 is energized to rotate in one or the other direction, the rack 34 is moved forward or rearward thereby to move the movable display unit 16 between the first and second positions.

If desired, a lift mechanism may be employed. That is, upon coming to the second position, the movable display unit 16 is moved down in the direction of the thickness of the fixed display unit 15 so that the screen of the movable display unit 16 becomes flush with the screen of the fixed display unit 15.

In the following, operation of the information display device 100 will be described with reference to FIGS. 1 and 2.

For ease of understanding, the description will be commenced with respect to a condition wherein the movable display unit 16 assumes the second position as shown in FIG. 1. That is, in this condition, the movable display unit 16 is positioned just beside the fixed display unit 15 exposing the given end portion of the fixed display unit 15.

When now the fixed display unit 15 is energized, a visual information or image is displayed on the screen 15*a*. The information displaying light beam from the screen 15*a* is reflected backward by the half mirror 14 and then reflected forward by the concave mirror 13 thereby to produce a magnified virtual image 20 which can be viewed by the driver (more specifically, the eye point "P" of the driver) through the half mirror 14 and the window opening 12.

When then the movable display unit 16 assuming the second position is energized, a visual information or image is displayed on the screen of the movable display unit 16. Similar to the case of the above-mentioned fixed display unit 15, the information displaying light beam from the screen is reflected backward by the half mirror 14 and then reflected forward by the concave mirror 13 thereby to produce a magnified virtual image 21. Due to the nature of the positional relationship between the movable display unit 16, the concave mirror 13 and the eye point "P" of the front seat passenger, the magnified virtual image 21 can be viewed by only the front seat passenger, as is understood from FIG. 1.

Thus, when both the fixed and movable display units 15 and 16 are kept energized, the driver can recognize only the virtual image 20 needed by him or her, and the front seat passenger can watch only the virtual image 21 (TV program) enjoyed by him or her.

When the virtual image 21 for the front seat passenger shows information needed by the driver, the front seat passenger can recognize the existing condition of the vehicle. This is very convenient when he or she is an instructor who is teaching the driving technique to a beginning driver.

When the drive mechanism 30 is energized to rotate in a given direction, the movable display units 16 is moved to the first position as shown in FIG. 5. Under this condition, the magnified virtual image 21 provided by the movable display unit 16 can be viewed by only the driver due to the nature of the positional relationship between movable display unit 16, the concave mirror 13 and the eye point "P" of the driver. Thus, when both the fixed and movable display units 15 and 16 are kept energized, the driver can recognize both the virtual image 20 provided by the fixed display unit 15 and the virtual image 21 provided by the movable display unit 16.

Of course, when the vehicle is running, the image 21 provided by the movable display unit 16 should show information really needed by the driver, such as a map for car navigation or the like.

Referring to FIGS. 6 to 8, there is shown an information display device of a second embodiment of the present invention, which is generally designated by numeral 200.

In FIG. 7, designated by numeral 11 is a housing which is to be mounted in the display device mounting space 2 (see FIG. 9) formed in the instrument panel 1. The housing 11 has a window opening 12 which faces toward the vehicle cabin. A concave mirror 13 is arranged in a depth portion of the housing 11. A half mirror 14 is arranged in the housing 11 between the window opening 12 and the concave mirror 13 and inclined relative to the housing 11.

Below the half mirror 4, there are arranged first and second fixed display units 15A and 15B. The first display unit 15A comprises a liquid crystal display which may display TV and/or a navigation map, while the second display device 15B comprises a liquid crystal display which may display various information really needed by the driver.

As is understood from FIG. 6, upon assembly in a motor vehicle having a steering wheel at the right side, the information display device 200 is so oriented that the first and second fixed display units 15A and 15B are positioned at right and left sides in the housing 11 when viewed from a rear position of the device 200. Designated by reference "C"

is a center line which travels through the center of the housing 11. As shown, the first and second display units 15A and 15B are positioned near the right and left edges of the concave mirror 13 for the reason which will be apparent hereinafter.

In the following, operation of the information display device 200 will be described with reference to FIG. 6.

When only the second display unit 15B is energized, a visual information or image needed by the driver is displayed on the screen of the unit 15B. The information displaying light beam from the screen is reflected backward by the half mirror 14 and then reflected forward by the concave mirror 13 thereby to produce a magnified virtual image 20B which can be viewed by only the driver through the half mirror 14 and the window opening 12.

When then the first display unit 15A is energized, a visual information or image, such as TV program, is displayed on the screen of the unit 15A. The information displaying light beam from the screen is reflected backward by the half mirror 14 and then reflected forward by the concave mirror 13 thereby to produce a magnified virtual image 20A which can be viewed by only the front seat passenger through the half mirror 14 and the window opening 12.

That is, due to the nature of the positional relationship between the two display units 15A and 15B, the concave mirror 14, the eye point "P" of the driver and the eye point "P'" of the front seat passenger, the virtual image 20B can be viewed by only the driver and the other virtual image 20A can be viewed by only the front seat passenger as is described hereinabove.

When the virtual image 20A for the front seat passenger shows information needed by the driver, the front seat passenger can recognize the exixting condition of the vehicle. This is very convenient when he or she is an instructor who is teaching the driving technique to a beginning driver.

When the front seat passenger is not present, the first display unit 15A is deenergized. Of course, in this case, there is no image provided by the first display unit 15A.

What is claimed is:

1. In a motor vehicle having an instrument panel at a front portion of a vehicle cabin and first and second given positions in the vehicle cabin, said first and second given positions being laterally spaced with respect to the vehicle cabin, an information display device comprising:

a housing installed in said instrument panel, said housing having a window opening which faces toward the vehicle cabin;

a first display unit installed in said housing and having an upward facing screen on which a first image is displayed;

a second display unit installed in said housing and having an upward facing screen on which a second image different from said first image is displayed;

an inclined half mirror installed in said housing, said half mirror being positioned above both said first and second display units, so that image forming light beams from the respective screens of the first and second display units are reflected toward a front of said vehicle by the half mirror; and

a concave mirror installed in said housing to reflect said image forming light beams from said half mirror toward the vehicle cabin through said window opening, the reflected image forming light beams from said concave mirror producing respective magnified virtual images of said first and second images,

wherein the respective screens of said first and second display units are laterally spaced with respect to the vehicle cabin, so that the magnified virtual image of said first image can be viewed from only said first given position and the magnified virtual image of said second image can be viewed from only said second given position.

2. An information display device as claimed in claim 1, wherein each of said first and second display units is a liquid crystal display.

3. An information display device as claimed in claim 1, wherein said first display unit displays an image needed by a front seat passenger and said second display unit displays an image needed by a driver.

4. An information display device as claimed in claim 3, wherein said first and second display units are arranged near opposed lateral edges of said concave mirror.

5. An information display device as claimed in claim 1, further comprising a moving mechanism by which said first display unit is movable in the lateral direction in said housing relative to said second display unit.

6. An information display device as claimed in claim 5, wherein said moving mechanism comprises:

a pair of rails on which said first display unit is slidably disposed; and

a drive mechanism for driving said first display unit between first and second positions on said rails,

wherein said first position is a position wherein said first display unit is placed above an end portion of the screen of said second display unit, while said second position is a position wherein said first display unit is placed just beside the screen of said second display unit, thereby exposing said end portion of the screen of said second display unit.

7. An information display device as claimed in claim 6, wherein said drive mechanism comprises:

an electric motor;

a speed reduction gear operatively connected to said electric motor;

a pinion mounted on an output shaft of said speed reduction gear;

a rack meshed with said pinion; and

a connector connecting said rack with said first display unit.

8. An information display device as claimed in claim 1, wherein the first image and the second image respectively displayed on the first and second display units travel along respective optical paths via only the inclined half mirror and the concave mirror from the first and second display units to the first and second given positions, respectively.

9. In a motor vehicle having an instrument panel at a front portion of a vehicle cabin, and first and second given positions in the vehicle cabin, said first and second given positions being laterally spaced with respect to the vehicle cabin, an information display device comprising:

a housing installed in said instrument panel, said housing having a single window opening which faces toward the vehicle cabin;

a first display unit installed in said housing and having an upward facing screen on which a first image is displayed;

a second display unit installed in said housing and having an upward facing screen on which a second image is displayed;

an inclined half mirror installed in said housing and positioned above both said first and second display

units, so that two types of image forming light beams from the respective screens of the first and second display units are reflected toward a front of said vehicle by the half mirror; and

a concave mirror installed in said housing to reflect the two types of image forming light beams from said half mirror toward said first and second given positions of said vehicle cabin, respectively, through said single window opening to produce respective magnified virtual images of said first and second images,

wherein the reflected two types of image forming light beams from said concave mirror are intersected with each other before reaching to said first and second given positions, and

wherein said window opening is sized and arranged so as to permit the magnified virtual images of said first and second images to be viewed from only said first and second given positions, respectively.

10. An information display device as claimed in claim **9**, wherein the respective screens of said first and second display units are laterally spaced with respect to the vehicle cabin.

11. An information display device as claimed in claim **9**, wherein each of said first and second display units is a liquid crystal display.

12. An information display device as claimed in claim **11**, wherein said first and second display units are arranged near opposed lateral edges of said concave mirror.

13. An information display device as claimed in claim **9**, further comprising a moving mechanism by which said first display unit is movable in the lateral direction in said housing relative to said second display unit.

14. An information display device as claimed in claim **13**, wherein said moving mechanism comprises:

a pair of rails on which said first display unit is slidably disposed; and

a drive mechanism for driving said first display unit between first and second positions on said rails,

wherein said first position is a position wherein said first display unit is placed above an end portion of the screen of said second display unit, while said second position is a position wherein said first display unit is placed just beside the screen of said second display unit thereby exposing said end portion of the screen of said second display unit.

15. An information display device as claimed in claim **14**, wherein said drive mechanism comprises:

an electric motor;

a speed reduction gear operatively connected to said electric motor;

a pinion disposed on an output shaft of said speed reduction gear;

a rack meshed with said pinion; and

a connector connecting said rack with said first display unit.

16. An information display device as claimed in claim **9**, wherein the reflected two types of image forming light beams travel along respective optical paths via only the inclined half mirror and the concave mirror from the first and second display units to the first and second given positions, respectively.

17. An information display device as claimed in claim **16**, wherein the magnified virtual images of said first and second images are capable of being viewed simultaneously from said first and second given positions, respectively.

18. In a motor vehicle having an instrument panel at a front portion of a vehicle cabin and driver's and front passenger's seating positions in the vehicle cabin, an information display comprising:

a housing installed in said instrument panel, said housing having a window opening which faces toward the vehicle cabin;

a first display unit installed in said housing at a position near said driver's seating position, said first display unit having an upward facing screen on which a first image needed by a front seat passenger on said front passenger's seating position is displayed;

a second display unit installed in said housing at a position near said front passenger's seating position, said second display unit having an upwardly facing screen on which a second image needed by a driver on said driver's seating position is displayed;

an inclined half mirror installed in said housing and positioned above both said first and second display units, so that two types of image forming light beams from the respective screens of said first and second display units are reflected toward a front of said vehicle by said half mirror; and

a concave mirror installed in said housing to reflect the two types of image forming light beams from said half mirror toward said vehicle cabin through said window opening to produce respective magnified virtual images of the first and second images,

wherein the reflected two types of image forming light beams from said concave mirror are intersected with each other before reaching to said front passenger's and driver's seating positions, so that the magnified virtual image of the first image can be viewed from only said front passenger's seating position and the magnified virtual image of the second image can be viewed from only said driver's seating position.

19. An information display device as claimed in claim **18**, wherein the reflected two types of image forming light beams travel along respective optical paths via only the inclined half mirror and the concave mirror from the first and second display units to the front passenger's seating position and the driver's seating position, respectively.

20. An information display device as claimed in claim **19**, wherein the reflected two types of image forming light beams are capable of being viewed simultaneously from the front passenger's seating position and the driver's seating position, respectively.

* * * * *

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Regan

(10) **Patent No.: US 6,218,934 B1**
(45) **Date of Patent: *Apr. 17, 2001**

(54) **MINI-TRIP COMPUTER FOR USE IN A REARVIEW MIRROR ASSEMBLY**

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(73) Assignee: **DaimlerChrysler Corporation**, Auburn Hills, MI (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/358,318**

(22) Filed: **Jul. 21, 1999**

(51) **Int. Cl.**[7] **B60Q 1/00**

(52) **U.S. Cl.** **340/438**; 340/425.5; 340/461; 340/465; 340/469; 340/988; 345/7; 345/8; 345/102; 345/87

(58) **Field of Search** 340/438, 425.5, 340/988, 461, 469, 468; 364/107, 424, 424.04, 444; 345/7, 102, 8, 87

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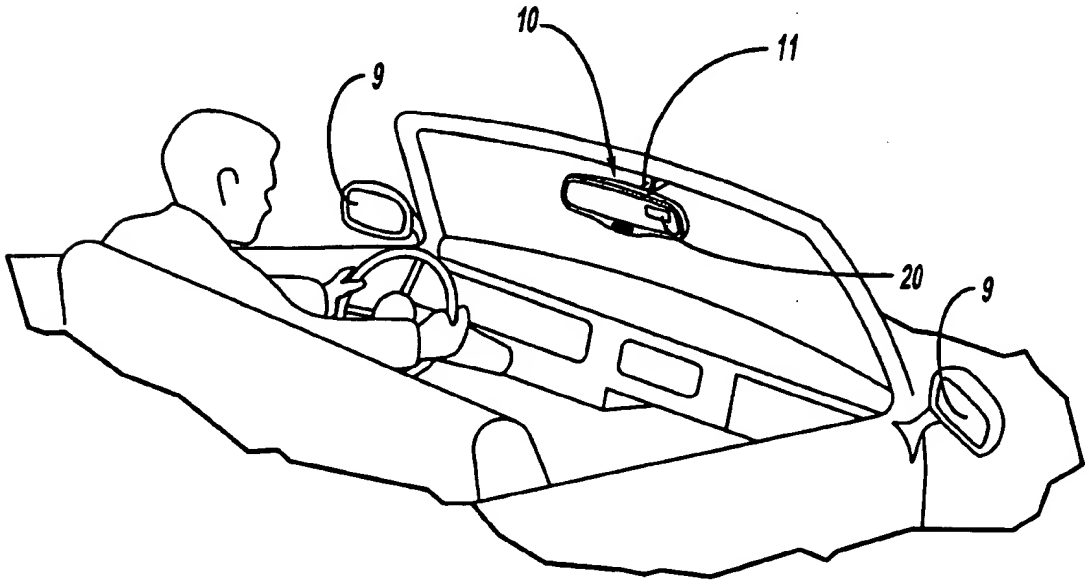
Assistant Examiner—Hung Nguyen
(74) *Attorney, Agent, or Firm*—Roland A. Fuller, III

(57) **ABSTRACT**

A trip computer is incorporated into a rearview mirror assembly for displaying trip information to the driver of a motor vehicle. The mirror assembly includes a reflective element, a housing for the reflective element, a trip computer for determining vehicle trip information, and a display device for displaying the vehicle trip information, where the display device is electrically connected to the trip computer and embedded within the reflective element.

17 Claims, 6 Drawing Sheets



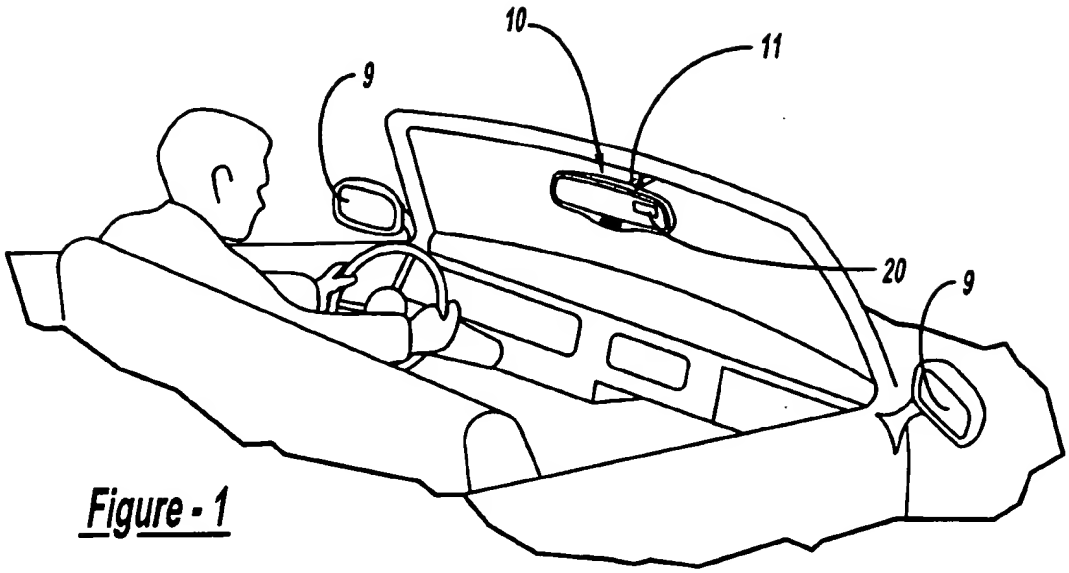


Figure - 1

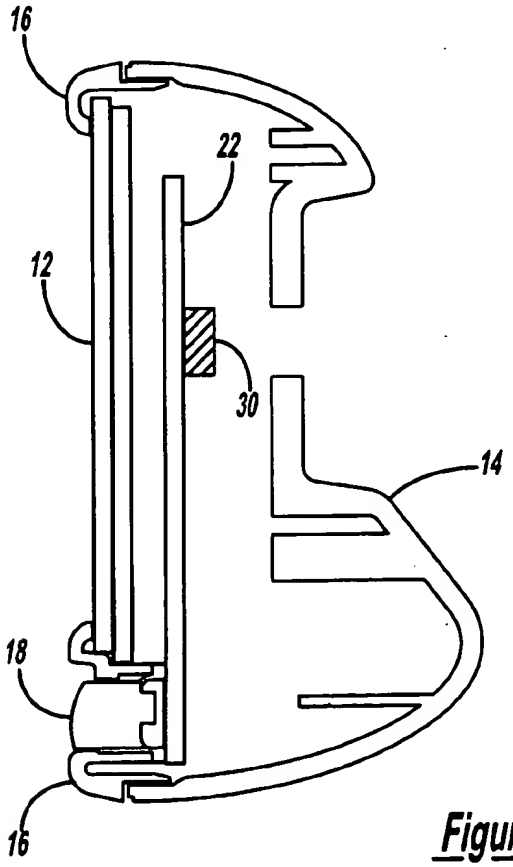


Figure - 4

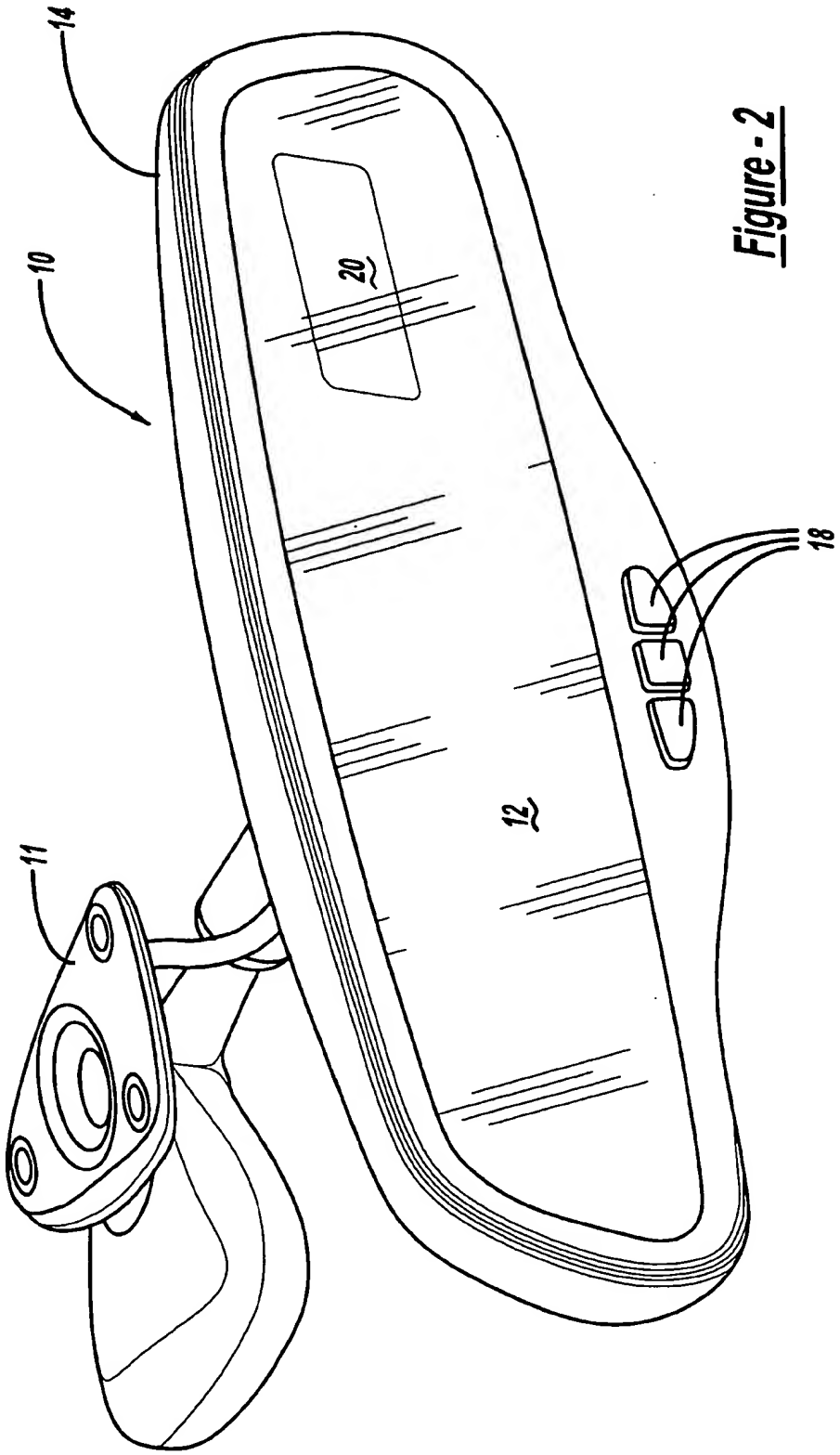


Figure - 2

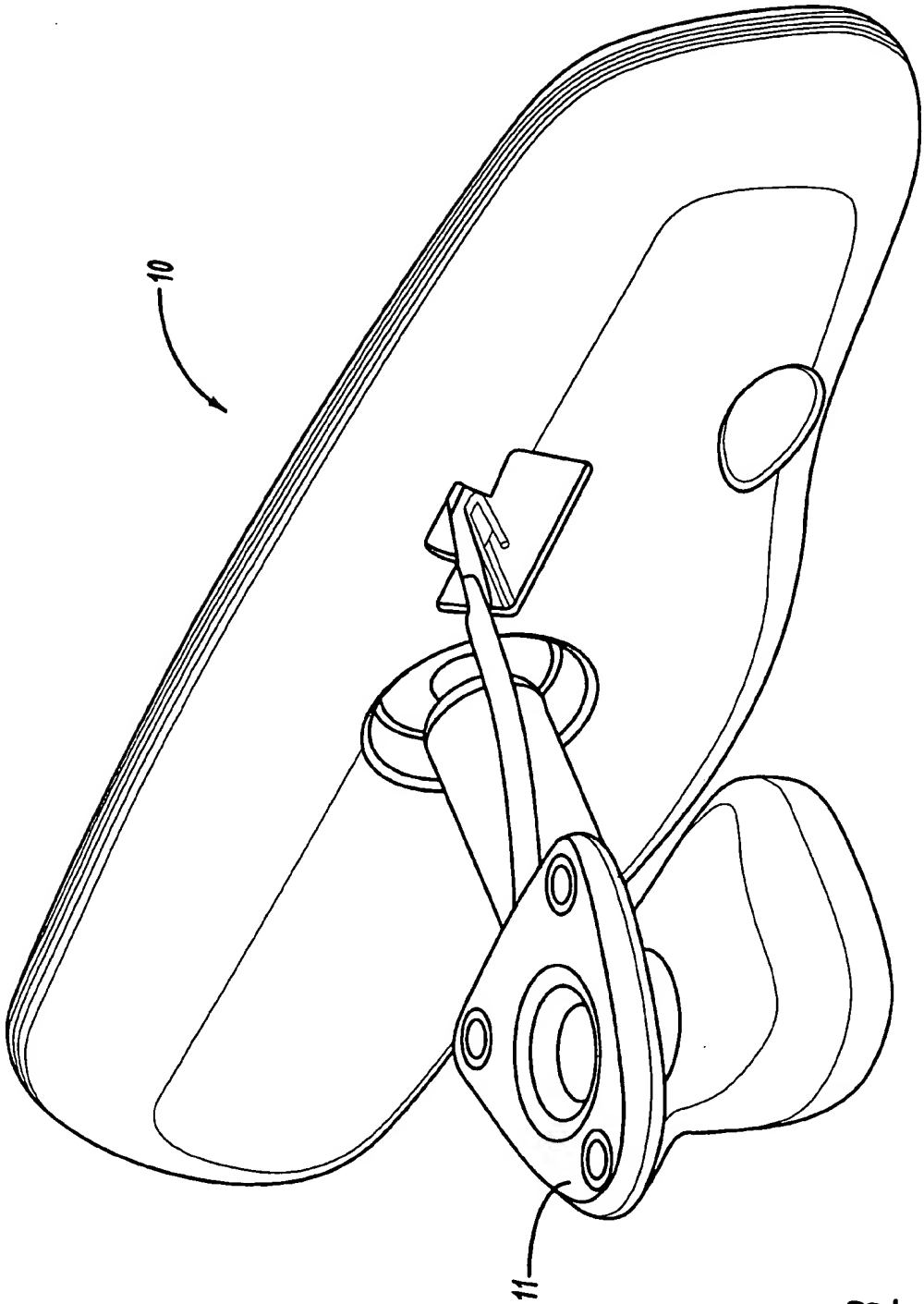


Figure - 3

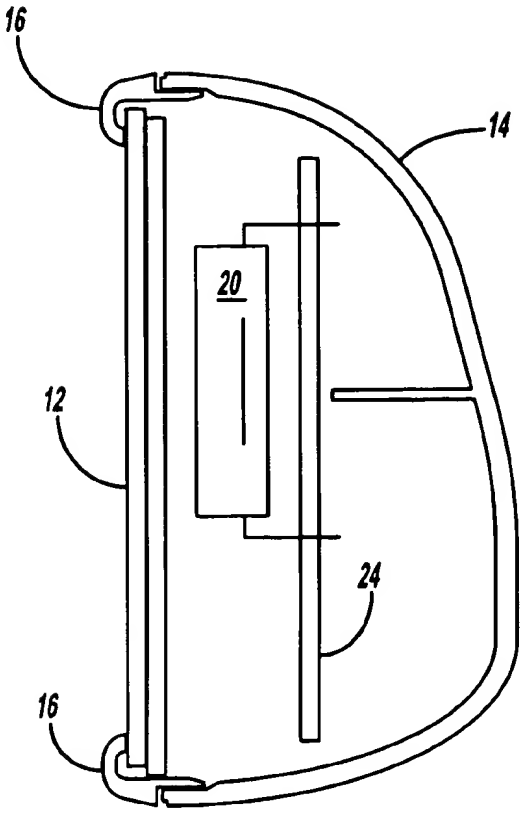


Figure - 5

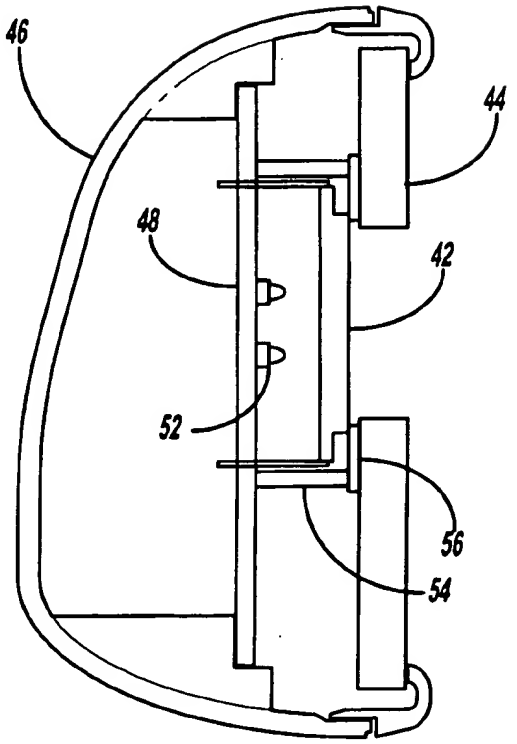


Figure - 6

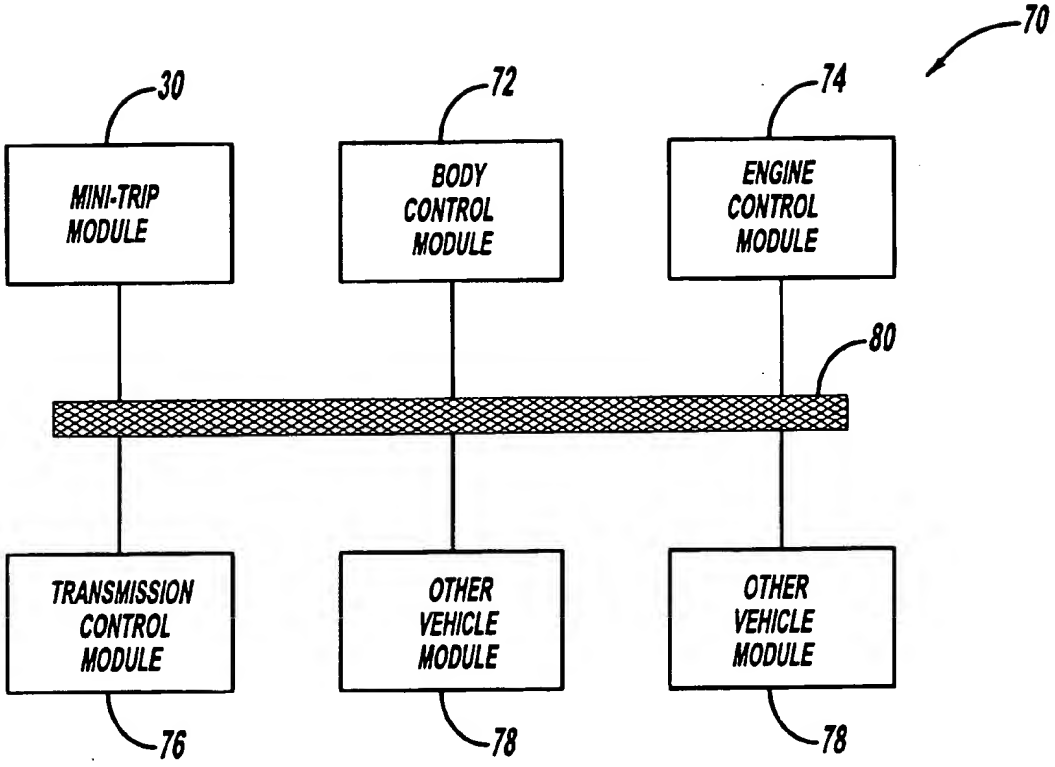

70
30
72
74
MINI-TRIP MODULE
BODY CONTROL MODULE
ENGINE CONTROL MODULE
80
TRANSMISSION CONTROL MODULE
OTHER VEHICLE MODULE
OTHER VEHICLE MODULE
76
78
78

Figure - 7

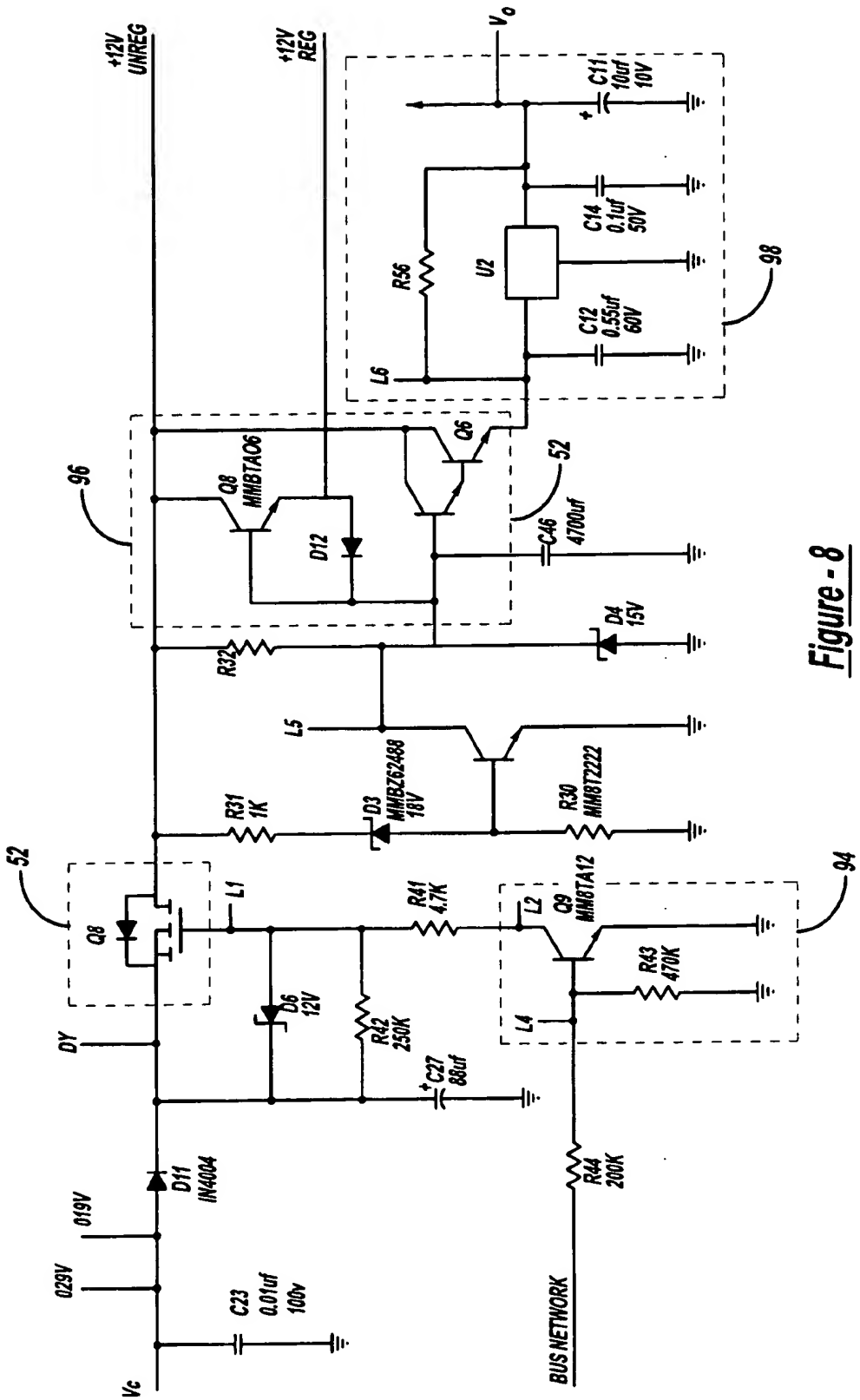

+12V UNREG
+12V REG
Vo
C11 10uf 10V
C14 0.1uf 50V
U2
R56
C12 0.55uf 60V
98
L6
96
Q8 MMBTA06
Q6
52
D12
C46 4700uf
D4 15V
R32
L5
R31 1K
D3 MMBZ62488 16V
R30 MMBT2222
52
Q8
L1
R41 4.7K
L2
Q9 MMBTA12
94
R43 470K
D6 12V
R42 250K
L4
DY
C27 88uf
D11 IN4004
R44 200K
019V
029V
C23 0.01uf 100v
BUS NETWORK
Vc

Figure - 8

MINI-TRIP COMPUTER FOR USE IN A REARVIEW MIRROR ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a rearview mirror assembly for use in a motor vehicle and, more particularly, to a mini-trip computer embedded in a center-mounted rearview mirror assembly.

2. Discussion

Rearview mirrors, both center-mounted inside a vehicle passenger compartment and side-mounted outside the passenger compartment, are used to enable a driver of the vehicle to observe objects that are behind the vehicle while the driver's gaze remains directed generally forward. Such mirrors are ubiquitous means for providing actual visual images of objects that are behind the vehicles.

A significant amount of data is also presented to a driver of the vehicle in analog form (e.g., by gages) and/or in digital form (e.g., by digital display instrumentation). As recognized by the present invention, it can be advantageous to combine data sources not only to realize manufacturing cost savings, but also to promote safety and effectiveness in data presentation. In the context of a rearview mirror, the present invention recognizes that most drivers readily accept and use mirrors to know what objects are behind their vehicles, thereby improving driving safety. The present invention further recognizes that the use of mirrors can be promoted even further by presenting additional data on the mirrors to stimulate relatively more frequent use of the mirrors. Moreover, the effectiveness of the presentation of the data is improved by presenting data on a mirror that otherwise would be presented at a perhaps less convenient location in the vehicle. In other words, the present invention recognizes that it is possible that data presented on a mirror is more accessible than data presented in other locations that would not otherwise attract the driver's attention.

Nevertheless, problems exist with locating display devices on rearview mirror assemblies which may otherwise be exposed to considerable ambient light, such as in a convertible top vehicle. Therefore, it is also desirable to provide a display device for use in a mirror assembly, such as a liquid crystal display device, which does not exhibit diminished contrast when exposed to considerable ambient light.

It is further known to incorporate electronic components into the housing of a vehicle mirror assembly. For instance, it is known to mount courtesy lights and associated switches in the casing of an interior mirror assembly. In addition, electrochromatic rearview mirrors typically incorporate light sensors in order to detect light levels in the vicinity of the vehicle. In each of these cases, the electronic components are stand alone components which operate independent from the remainder of the vehicle data communication system.

On the contrary, a trip computer needs additional information from extraneous vehicle control modules in order to determine vehicle trip information. Most trip computers are located in the overhead console or in the instrument panel of the vehicle, and thus can be easily interfaced to the vehicle data communication system. However, in some convertible top vehicles there is no room to package a trip computer in the instrument panel of the vehicle.

Therefore, it is desirable to provide a rearview mirror assembly which incorporates a trip computer. In order to receive extraneous vehicle trip information, additional wires would have to be run from the trip computer in the mirror assembly to the instrument panel or other electronic components. As a result, the manufacturer would likely incur substantial additional costs for incorporating a trip computer into the mirror assembly. Thus, it is also desirable to interconnect the trip computer embedded in the mirror assembly via a single wire bus network to the other vehicle control modules in the vehicle. In this way, the trip computer no longer needs to be hardwired to receive an ignition on signal which is used to power up the mirror assembly. Moreover, the trip computer has access to any additional information needed for determining and displaying vehicle trip information. Lastly, it is desirable to provide a wake-up circuit which upon detection of bus activity over the bus network is able to power up the trip computer.

SUMMARY OF THE INVENTION

In accordance with the present invention, a trip computer is incorporated into a rearview mirror assembly for displaying trip information to the driver of a motor vehicle. The mirror assembly includes a reflective element, a housing for the reflective element, a trip computer for determining vehicle trip information, and a display device for displaying the vehicle trip information, where the display device is electrically connected to the trip computer and embedded within the reflective element.

Additional benefits and advantages of the present invention will become apparent to those skilled in the art to which this invention relates from a reading of the subsequent description of the preferred embodiment and the appended claims, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of the interior of a motor vehicle;

FIG. 2 is a front perspective view of a rearview mirror assembly in accordance with the present invention;

FIG. 3 is a rear perspective view of the rearview mirror assembly of the present invention;

FIG. 4 is a cross-sectional view, taken along A—A of FIG. 2, through the center of the rearview mirror assembly of the present invention;

FIG. 5 is a cross-sectional view, taken along B—B of FIG. 2, through the display device of the rearview mirror assembly of the present invention;

FIG. 6 is a cross-sectional view, taken along B—B of FIG. 2, of an alternative embodiment of the rearview mirror assembly of the present invention;

FIG. 7 is a block diagram showing the components of a vehicle data communication system in accordance with the present invention; and

FIG. 8 is a schematic of a wake-up circuit for use in the trip computer of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a schematic view illustrating various rearview mirror assemblies which are adapted in a conventional manner to be installed in a motor vehicle. For instance, an interior center-mounted rearview mirror assembly **10** couples to the front windshield via a support **11** which extends from the mirror assembly **10**. As will be apparent to

those skilled in the art, the rearview mirror assembly **10** faces the rear of the vehicle and can be viewed by the driver of the vehicle. While the following description is provided with reference to an interior center-mounted rearview mirror assembly, it is readily understood that the explanation is applicable to other interior and/or external mirror assemblies which are for use in a motor vehicle.

Referring to FIG. **2**, the rearview mirror assembly **10** includes a mirror member **12**, a housing **14**, and a plurality of switches **18**, and a display device **20** embedded into the mirror member **12**. The switches **18** are used to operate one or more electronic components associated with the mirror assembly **10**, such as map courtesy lights (not shown) mounted on the underside of the mirror assembly **10**.

In a first preferred embodiment, an electrochromic mirror is used as the mirror member **12** for the rearview mirror assembly **10**. In general, an electrochromic mirror automatically dims to eliminate unwanted headlight glare from following vehicles. To do so, the electrochromic mirror is comprised of a relatively thin electrochromic medium sandwiched and sealed between two glass elements. More specifically, the electrochromic medium is disposed in a sealed chamber defined by a transparent front glass element, a peripheral edge seal and a rear glass element. Conductive layers are provided on the inside of the front and rear glass elements. The conductive layers are connected to electronic circuitry which is operable to electrically energize the electrochromic medium. The rear glass element also includes a reflective layer which provides the reflective characteristic of the mirror. In this case, the mirror assembly further includes a drive voltage supply for the electrochromic medium, an ambient light sensor, a glare light sensor, as well as their associated electronic circuitry.

In operation, a forward-facing ambient light sensor recognizes low ambient light levels and signals to the electrochromic mirror to begin detecting unwanted glare. A rearward-facing glare sensor then detects glare from vehicles traveling behind the vehicle and sends a voltage to the electrochromic medium in proportion to the amount of glare detected. As a result, the mirror dims in proportion to the glare. When the glare is no longer detected, the glare sensor ceases to provide a voltage to the mirror. Although the present invention is not limited to an electrochromic mirror, an exemplary electrochromic mirror is manufactured by the Gentex Corporation of Zeeland, Mich.

There are a variety of known housings for rearview mirror assemblies, but a preferred housing **14** is shown in FIGS. **2–5**. In this case, the housing **14** is a single-piece casing molded from a thermoplastic material. A bezel **16** is used to conceal the peripheral edge portions of the mirror member **12** as well as to couple the mirror member **12** to the housing **14**. Thus, the bezel **16** extends around the entire periphery of an opening in the housing **14** and attaches to an interior surface of the housing **14**. There are a variety of known bezel designs which may be used to couple the mirror member **12** to the housing **14**.

The housing **14** is further adapted to support a circuit board **22**. The circuit board **22** is preferably a conventional circuit board, such that it includes a series of metal traces deposited on a substrate. In this way, various electronic components and circuitry can be incorporated into the rearview mirror assembly **10**. In accordance with the present invention, a trip computer **30** for determining vehicle trip information is coupled to the circuit board **22**. A trip computer generally provides the driver with vehicle trip information, including but not limited to outside ambient temperature, compass reading, average fuel economy, instantaneous fuel economy, a trip odometer reading and elapsed ignition on time. One skilled in the art will readily recognize that extraneous vehicle information is needed for determining the above-described vehicle trip information at the trip computer **30**. As will be more fully explained below, the trip computer **30** is therefore electrically connected via a bus network to the vehicle data communication system. An exemplary mini-trip module for use in a mirror assembly is available from DaimlerChrysler of Auburn Hills, Mich.

A display device **20** is used for displaying the vehicle trip information to the driver. Thus, the display device **20** is electrically connected to the trip computer **30**. As shown in FIG. **5**, the display device **20** is positioned behind the mirror member **12**, such that a section of its reflective material is partially removed to exposed the display device **22** to the driver. The display device **20** is coupled to a second display circuit board **24**, where the housing **14** is adapted to support the second circuit board **24**. Although a vacuum fluorescent display is presently preferred, this is not intended as a limitation on the broader aspects of the present invention. On the contrary, other types of display devices may be suitable, including liquid crystal displays, field emission displays and light emitting diode displays.

An alternate embodiment of the rearview mirror assembly **40** is shown in FIG. **6**. To improve high ambient daylight visibility and reduce electromagnetic interference inherent with the drive power supply associated with VF display devices, a liquid crystal display (LCD) device **42** is incorporated into the rearview mirror assembly **40**. Although different types of LCD devices may be incorporated into the present invention, an exemplary LCD device is manufactured by Optrex America, Inc. of Detroit, Mich.

Again, the rearview mirror assembly **40** includes a mirror member **44** and a housing **46**, where the reflective member **44** couples to an interior surface of the housing **46**. As shown, the LCD device **42** is positioned behind the mirror member **44**, such that a section of its reflective material is partially removed to exposed the LCD device **22** to the driver. In this case, the LCD device **42** is coupled via two or more soldering pins **47** to a circuit board **48**. The circuit board **48** is in turn coupled to the interior surface of the housing **46**.

Two or more sub-miniature light emitting diodes (LEDs) **52** serve as the light source for the LCD device **42**. The LEDs **52** are also coupled to the circuit board **48**. As shown, a light shield **54** for enclosing the LEDs **52** is positioned between the reflective member **44** and the circuit board **48**. In this way, the light shield **54** is used to eliminate any ambient light which may diminish the contrast of the LCD device **42**. An anti-rattle pad **56** for reducing vibrations may be positioned between the light shield **54** and the mirror member **44**. It is also noteworthy that an incandescent lamp may be used in place of the LEDs. In this case, a parabola surface may be used to focus and direct the light towards the LCD device **42**.

In accordance with the present invention, a vehicle data communication system **70** is depicted in FIG. **7**. In order to receive extraneous vehicle trip information, the trip computer **30** is interconnected to other vehicle control modules within the vehicle. For instance, a body control module **72**, an engine control module **74**, a transmission control module **76** and other vehicle control modules **78** may communicate with the trip computer **30** using a bus network architecture. The various control modules communicate with each other via messages whose structure and characteristics are defined

by a known communication protocol (e.g., the SAE J1850 standard). A single wire serial data communication network or bus network **80** is used to carry the messages between the vehicle control modules. As will be apparent to one skilled in the art, a two wire bus network might also be used to interconnect the modules. Each vehicle control module usually includes a microprocessor or microcontroller and its associated bus interface circuitry as is well known in the industry.

In accordance with the present invention, the trip computer **30** receives vehicle speed, odometer information and outside air temperature information from the engine control module **74**. This information is then used to calculate at least some of the vehicle trip information. In addition, the trip computer **30** receives an ignition on message from the body control module **72**. The ignition on message may be used by the trip computer **30** to power up its display device and/or the electrochromic mirror.

Furthermore, by interfacing with other vehicle control modules, the trip computer **30** is able to incorporate other enhanced functionality into the mirror assembly **10**. For instance, the trip computer **30** may receive gear selection information from the transmission control module **76**. Upon detecting that the vehicle is in reverse, the trip computer **30** may terminate the anti-glare feature of an electrochromic mirror. The trip computer **30** may also transmit information to other vehicle control modules. For example, when a courtesy map light is turned on, a message is sent by the trip computer **30** to the body control module **72**. In the event the ignition is turned off and the light is inadvertently left on by the driver, the light can be turned off as part of a typical time-out function provided by the body control module **72**. By interfacing the trip computer with other vehicle control modules, it is envisioned that other functions may be incorporated into the mirror.

In order to power up the trip computer, the present invention utilizes a wake-up circuit which is responsive to any bus activity occurring in the vehicle data communication system **70**. A preferred embodiment of a wake-up circuit **90** is shown in FIG. **8**. The wake-up circuit **90** includes a signal input stage **92**, a bus detection stage **94**, a noise isolation stage **96**, and a signal output stage **98**. Upon detecting bus activity on the bus network **80**, the bus detection stage **94** switches on the input stage **92**. As a result, the input stage **92** provides voltage to the output stage **98** which in turn applies power to the trip computer **30**. Once powered up, the trip computer **30** then waits for the body control module **72** to send an ignition on signal over the bus network **80**. When the ignition on signal is received by the trip computer **30**, it will in turn power up the display device **20**. In this way, the trip computer **30** does not need to be directly hardwired to receive an ignition on signal from the vehicle data communication system **70**.

More specifically, the bus detection stage **94** is comprised of transistor Q9 which electrically connects through a resistor **R44** to the bus network **80**. A bias voltage on the base of transistor Q9 indicates that messages are being sent (i.e., bus activity) over the bus network **80**. The bias voltage received by the bus detection stage **94** turns on transistor Q9. In addition, the emitter of transistor Q9 is coupled to ground and the collector of transistor Q9 is connected via resistor **R41** to the input stage **92**.

The input stage **92** provides a switching function for an input voltage source **102**. The input stage **92** is further defined as a MOSFET device **O8**, such that the drain of MOSFET device **O8** receives an input voltage V_i from the input voltage source **102**. When transistor Q9 is turned on, the MOSFET device **O8** is switched on. To do so, the collector of transistor Q9 is coupled through resistor **R41** to the gate of MOSFET device **O8**. When switched on, MOSFET device **O8** provides the input voltage V_i to the remainder of the wake-up circuit. In this case, the input voltage source **102** is supplied by the 12-volt battery of the motor vehicle. As will be apparent to one skilled in the art, the input stage **92** further includes known circuitry positioned between the input voltage source **102** and the source of MOSFET device **O8** for preventing voltage spikes in the circuit.

Next, a noise isolation stage **96** is positioned between the input stage **92** and the output stage **98**. The noise isolation stage **96** includes a series pass transistor Q6, where the collector of the second transistor is coupled to the source of MOSFET device **O8** from input stage **92**. The emitter of the second transistor is then coupled to the output stage **98**. In addition, the source of MOSFET device **O8** may be coupled through switches to other electronic components associated with the mirror assembly (e.g., courtesy lights). In this way, these components receive a 12-volt power supply. Again, the noise isolation stage **96** further includes known circuitry for preventing voltage spikes in the circuit as shown in FIG. **8**.

Lastly, the output stage **98** provides power to the logic circuitry associated with the trip computer **30**. In particular, the series pass transistor Q6 drives a 5-volt voltage regulator U2 on, thereby applying an output voltage V_o to the trip computer **30**. Thus, the series pass transistor Q6 of the noise isolation stage **96** isolates the voltage regulator U2 from any noise occurring in the earlier stages of the circuit.

While the above description constitutes the preferred embodiment of the invention, it will be appreciated that the invention is susceptible to modification, variation, and change without departing from the proper scope or fair meaning of the accompanying claims.

What is claimed is:

1. A rearview mirror assembly for displaying trip information to a driver of a motor vehicle, comprising:

a reflective element;

a housing for said reflective element;

a display device embedded within said reflective element;

a vehicle data communication system enabling a trip computer to communicate with a plurality of vehicle control modules via a serial data communication network;

wherein said serial data communication network has a single wire for a signal transmission medium; and

a trip computer for determining and displaying vehicle trip information, said trip computer being electrically connected to said display device and connected to said housing, said trip computer including a first microprocessor and being interconnected via the single wire of the communication network to a plurality of vehicle control modules, each vehicle control module having a microprocessor and associated bus circuitry for serially transmitting a plurality of signals over the single wire to the trip computer microprocessor, said trip computer being powered on upon detecting bus network activity, said vehicle control modules being remotely located from the rearview mirror assembly.

2. The rearview mirror assembly of claim **1** wherein said reflective element is further defined as an electrochromic mirror.

3. The rearview mirror assembly of claim **1** wherein said display device is a display selected from the group com-

prising: vacuum fluorescent displays, liquid crystal displays, field emission displays and light emitting diode displays.

4. The rearview mirror assembly of claim 1 wherein said display device is positioned behind said reflective element, such that a section of reflective material is partially removed from said reflective element, thereby exposing the display device to the driver of the motor vehicle.

5. The rearview mirror assembly of claim 1 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as a body control module, said trip computer receptive of ignition status information from said body control module and operative to control the electrochromic mirror based on the ignition status information from said body controller.

6. The rearview mirror assembly of claim 1 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as a transmission control module, said trip computer receptive of gear selection information and operative to control the electrochromic mirror based on the gear selection information from said transmission control module, said gear selection information enabling the trip computer to distinguish between three or more gears of the vehicle transmission.

7. The rearview mirror assembly of claim 1 further comprising a support adapted to extend from said housing and couple to a front windshield of the motor vehicle.

8. The rearview mirror assembly of claim 1 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as an engine control module, said trip computer receptive of vehicle speed information from said engine control module and operative to control the electrochromic mirror based on the vehicle speed information from said engine control module.

9. The rearview mirror assembly of claim 1 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as an engine control module, said trip computer receptive of vehicle odometer information from said engine control module and operative to control the electrochromic mirror based on the vehicle odometer information from said engine control module.

10. The rearview mirror assembly of claim 1 wherein the bus network includes a single wire seral data communication network.

11. A rearview mirror assembly for displaying trip information to a driver of a motor vehicle, comprising:

a electrochromic mirror;

a housing for said electrochromic mirror;

a liquid crystal display (LCD) device embedded within said electrochromic mirror; and

a trip computer for determining and displaying vehicle trip information, said trip computer being electrically connected to said LCD device and connected to said housing, said trip computer transmitting information regarding the rearview mirror assembly to at least one vehicle control module remotely located from the rearview mirror assembly.

12. The rearview mirror assembly of claim 11 wherein said LCD device is illuminated by two or more light emitting diodes positioned between said LCD device and said housing.

13. The rearview mirror assembly of claim 11 wherein said LCD device is positioned behind said electrochromic mirror, such that a section of reflective material is partially removed from said electrochromic mirror, thereby exposing the LOD device to the driver of the motor vehicle.

14. The rearview mirror assembly of claim 11 wherein said trip computer being interconnected via a bus network to the vehicle control module.

15. The rearview mirror assembly of claim 14 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as a body control module, said trip computer receptive of ignition status information from said body control module and operative to control the electrochromic mirror based on the ignition status information from said body controller.

16. The rearview mirror assembly of claim 14 wherein said reflective element is further defined as an electrochromic mirror and said vehicle control module is further defined as a transmission control module, said trip computer receptive of gear selection information and operative to control the electrochromic mirror based on the gear selection information from said transmission control module.

17. The rearview mirror assembly of claim 11 further comprising a support adapted to extend from said housing and couple to a front windshield of the motor vehicle.

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